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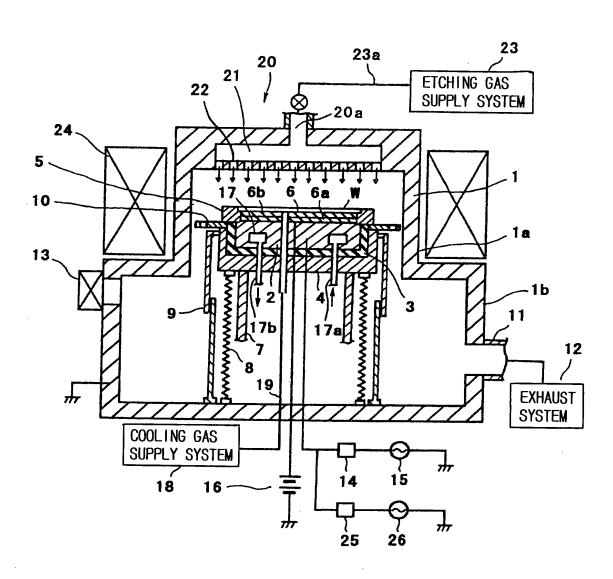


FIG. I

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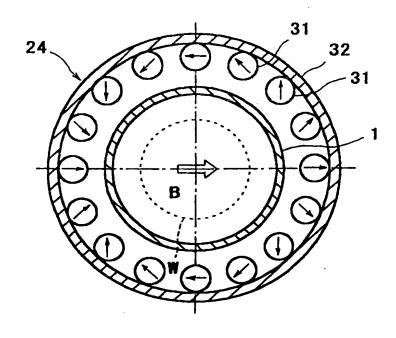


FIG. 2

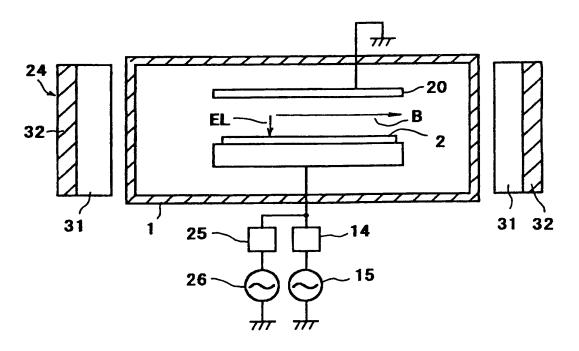


FIG. 3

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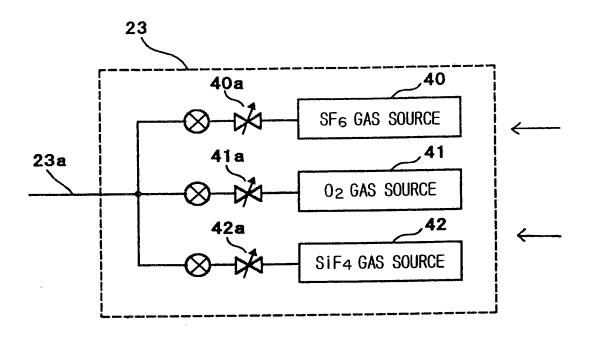


FIG. 4

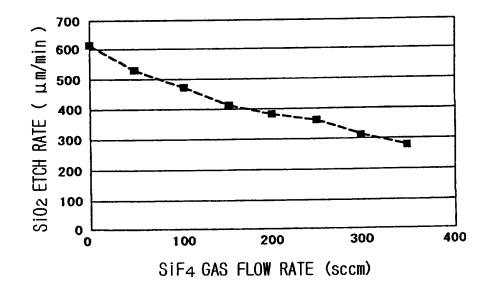


FIG. 5

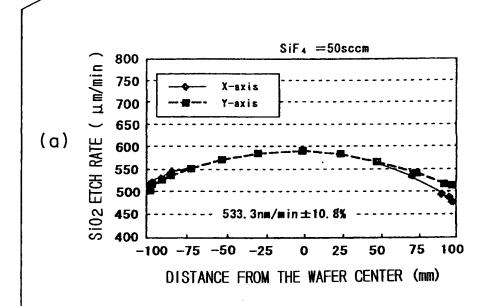
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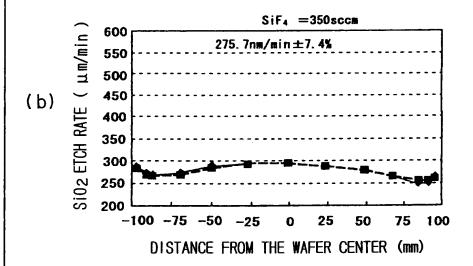


FIG. 6

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89.02 EDGE 88.31 ı ı 1 ١ ı TAPER ANGLE (deg.) 88.99 88.74 CEN-TER ı ı ı i 0 0.20 0.19 0 0.33 0 EDGE UNDERCUT (µm/min) 0 0 0.42 0 0.37 0.23 0 CEN-TER 32.6 30.0 29.8 39.2 40.7 35.7 37.1 EDGE SELECTIVITY Si ETCH 31.5 38.0 34.7 31.4 31.9 44.4 46.1 CEN-TER 4708 4920 3737 6498 4899 3847 5192 EDGE Si02 E/R (**Å**/min) 5468 5045 4636 3463 3377 6290 4581 CEN-TER 17.6 19.5 14.6 16.9 17.5 15.2 EDGE 15.1 (µm/min) Si E/R 17.5 19.8 14.8 15.4 15.6 17.2 17.4 CEN-TER SF6/02/SiF4 SF6/02/SiF4 SF6/02/SiF4 SF6/02/SiF4 (400/160/250)SF6/02/SiF4 (600/240/250)SF6/02/SiF4 **ETCHING GAS** (200/160/250)(200/80/250)(400/80/250) FLOW RATE (200/40/250) SF6/02 (400/75)(sccm) EXAMPLE EXAMPLE EXAMPLE **EXAMPLE EXAMPLE** EXAMPLE **EXAMPLE** COMPA-RATIVE A5 **A**2 A3 **A6** a ¥

5µm¢ TRENCH ETCH

F 6. 1

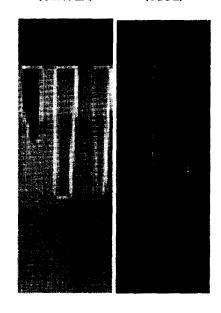
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[COMPARATIVE EXAMPLE a1]

(CENTER)

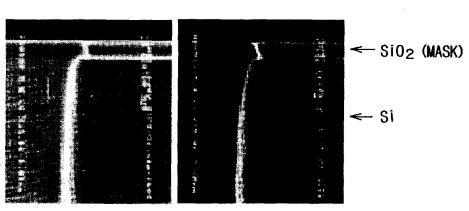
(EDGE)



ENLARGED VIEW OF A PART NEAR THE MASK

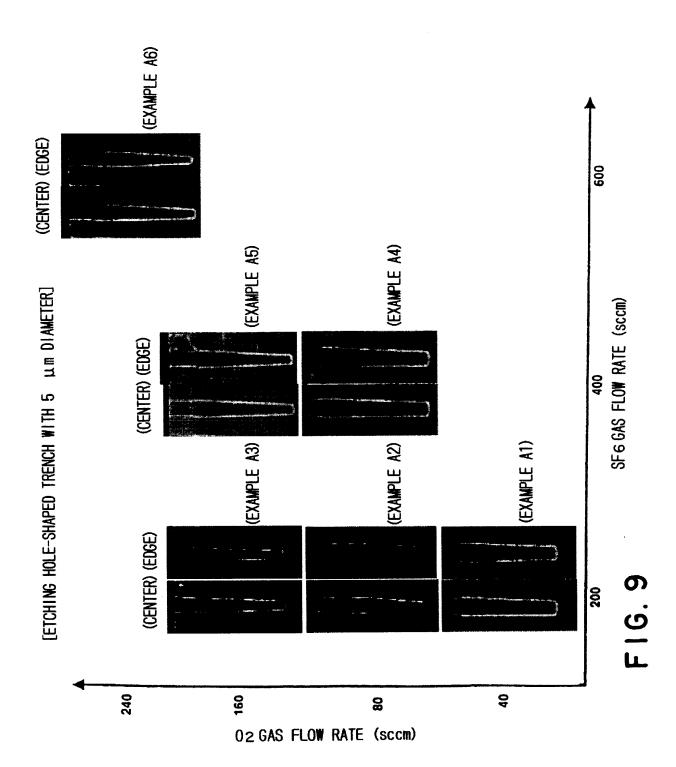
(CENTER)

(EDGE)



F1G. 8

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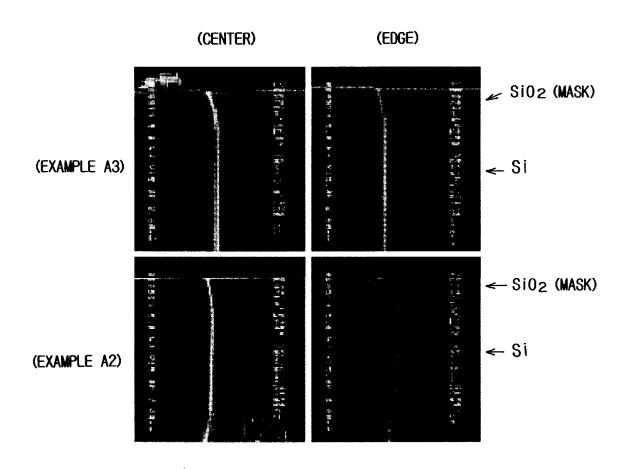
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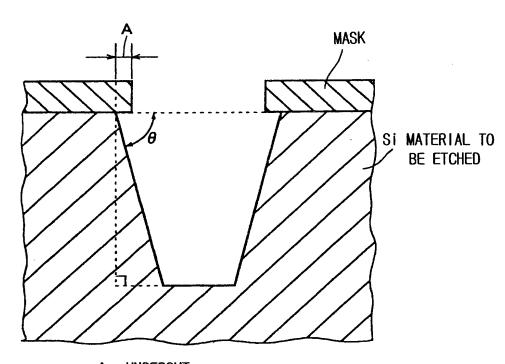
ENLARGED VIEW OF A PART NEAR THE MASK



F1G. 10

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A: UNDERCUT θ: TAPER ANGLE

F1G.11

20µmф TRENCH ETCH

| ~ | EDGE | 89.14 | | | 1 | | | | | | | | | 1 | |
|------------------------------------|-------------|--------------------|----|-------------|--------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|---------------|
| TAPER ANGLE (deg.) | | | | | | | | | | | | | | | |
| AN O) | CEN- TER | 89.33 | | | | ı | 1 | ' | | 1 | | ļ | 1 | l | |
| RCUT min) | EDGE | 0.39 | | | | C | 0 | 1 | | 1 | | 1 | | - | |
| UNDERCUT (µm/min) | CEN- TER | 0.74 | | | | c | 0 | 1 | | | | - | | 1 | |
| гсн тіvітץ | EDGE | 43.5 | | 49.0 | 44.3 | 5/6 | 04.0 | 38.1 | | 46.0 | 10.0 | 40 5 | 19.0° | 6 97 | 70.5 |
| Si ETCH SELECTIVITY | CEN- TER | 46.0 | | 45.1 | 43.1 | 69 1 | 02.1 | 45.5 | | 45.1 | 2 | 50 A | 9 | 45.9 | 4.0. |
| E/R nin) | EDGE | 6498 | | 4000 | 4033 | 7000 | 2047 | 7278 | 200 | 5100 | 0102 | 80LY | 2 | 4020 | 1350 |
| SiO ₂ E/R (Å/min) | CEN- TER | 6290 | | 3638 | 4000 | 2462 | 2403 | 7227 | 200 | 5468 | 2010 | 4501 | 1004 | 5045 | 2100 |
| :/R min) | EDGE | 28.3 | | 5 | 61.0 | 91.0 | 7.1.7 | 149 | 7:+ • | 0 86 | 6.02 | 6 66 | 6.62 | L 66 | 7.7.1 |
| Si E/R (µm/min) | CEN- TER | 28.9 | | 000 | 20.3 | 91 E | £1.3 | 15.4 | t. - | 246 | 64.0 | 999 | 7:07 | 9 CC | 7.70 |
| ETCHING GAS FLOW RATE (sccm) | | SF6/O2 (400/75) | | SF6/O2/SiF4 | (200/40/250) | SF6/02/SiF4 | (200/80/250) | SF6/O2/SiF4 | (200/160/250) | SF6/02/SiF4 | (400/80/250) | SF6/02/SiF4 | (400/160/250) | SF6/02/SiF4 | (600/240/250) |
| | | COMPA- RATIVE | b1 | EXAMPLE | 18 | EXAMPLE | B2 | EXAMPLE | B 3 | EXAMPLE | B4 | EXAMPLE | 82 | EXAMPLE | B6 |

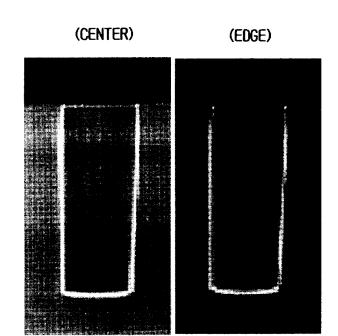
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[COMPARATIVE EXAMPLE b1]



ENLARGED VIEW OF A PART NEAR THE MASK

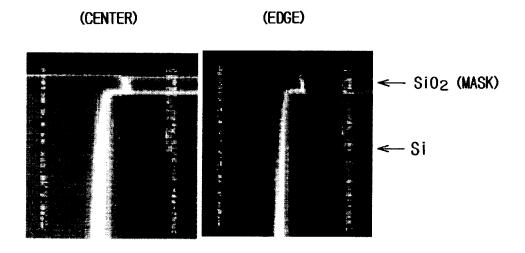
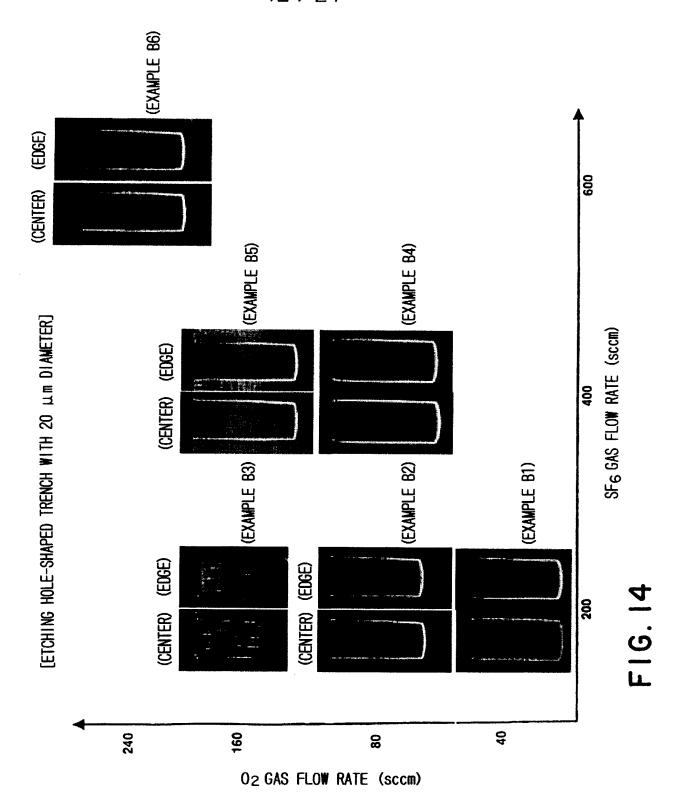


FIG. 13

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ENLARGED VIEW OF A PART NEAR THE MASK

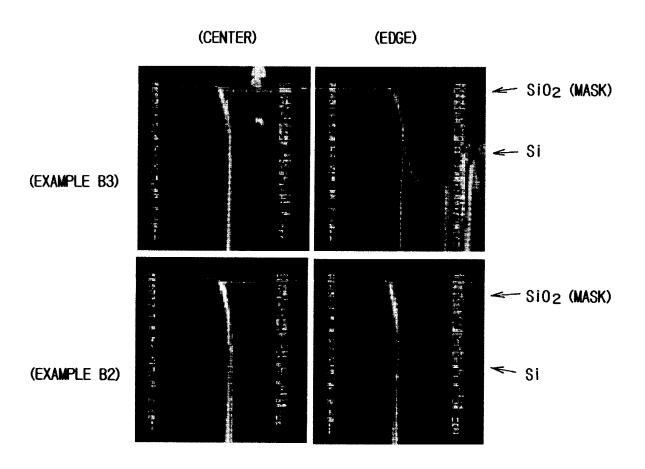
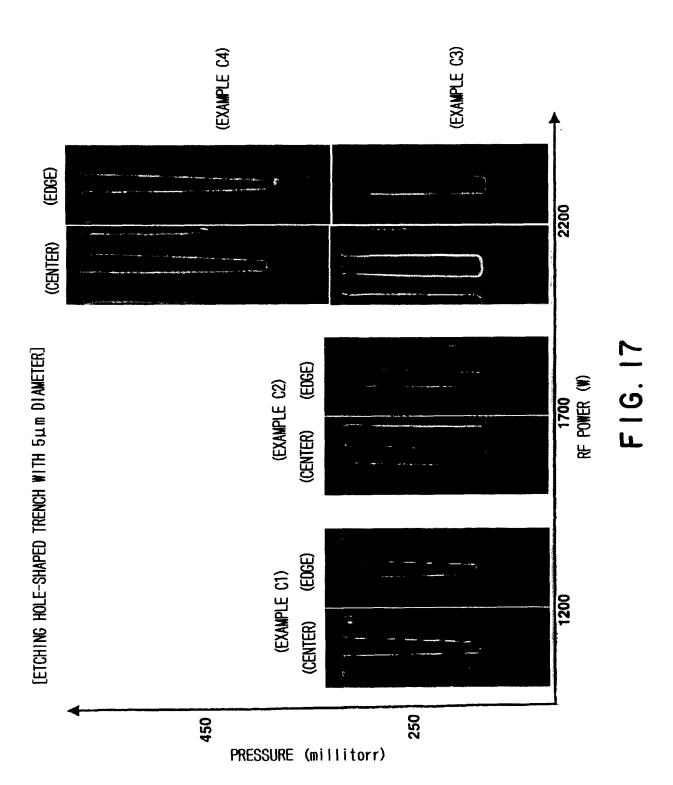


FIG. 15

5µmф TRENCH ETCH

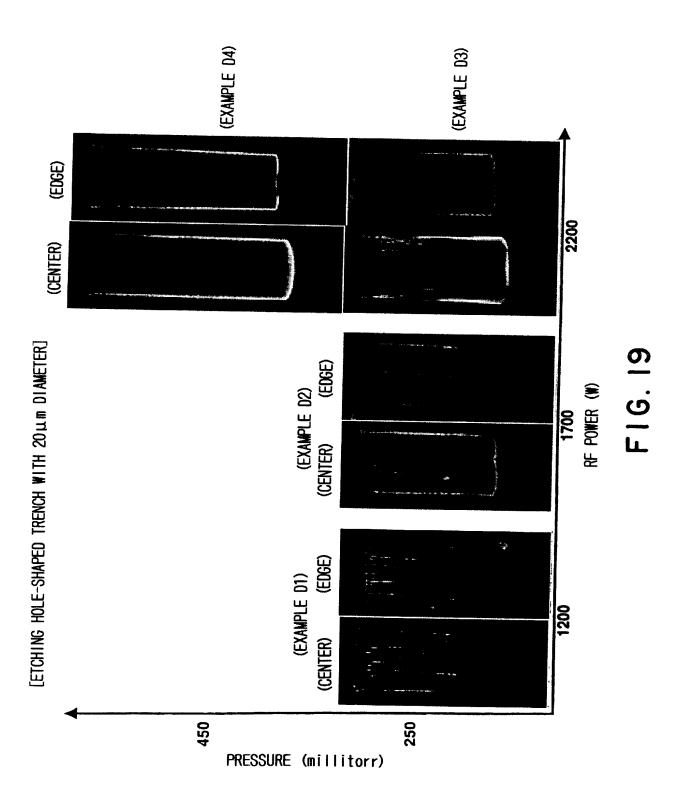
| | | | | | | | | | TAF | 000 |
|---------------|-------------|---------------|--------------------|-------------------|--------------|---------------------|---------------|------------------------|-----------------|-----------------|
| | RF POWER | PRES- SURE | Si E/R (µm/min) | Si E/R um/min) | Si02 (Å/r | SiO2 E/R (Å/min) | Si E SELEC | SI ETCH SELECTIVITY | ANGLE (deg.) | ANGLE (deg.) |
| | <u></u> | (mTorr) | CEN- TER | BDGE | CEN- TER | EDGE | CEN- TER | EDGE | CEN- TER | EDGE |
| EXAMPLE C1 | 1200 | 250 | 15.6 | 15.2 | 3377 | 3737 | 46.1 | 40.7 | 88.74 | 88.31 |
| EXAMPLE C2 | 1700 | 250 | 16.1 | 16.0 | 3663 | 4308 | 44.1 | 37.0 | 90.00 | 89.80 |
| EXAMPLE C3 | 2200 | 250 | 15.7 | 16.3 | 3513 | 3850 | 44.6 | 42.4 | 91.09 | ı |
| EXAMPLE C4 | 2200 | 450 | 21.0 | 21.2 | 3717 | 4848 | 56.6 | 43.8 | 89.09 | 88.70 |

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20µmф TRENCH ETCH

| | ם | 200 | SiE | Si E/R | Sio | 2 E/R | Si ETCH | TCH |
|---------------|------------|-------------------|-------------|--------|-------------|---------|-------------|--------|
| | POWER | ולבור ול המוני | (µm/min) | min) | (Å/1 | (Å/min) | SELECTIVITY | TIVITY |
| | (<u>x</u> | (mTorr) | GEN- TER | EDGE | CEN- TER | EDGE | CEN- TER | EDGE |
| EXAMPLE D1 | 1200 | 250 | 15.4 | 14.2 | 3377 | 3737 | 45.5 | 38.1 |
| EXAMPLE D2 | 1700 | 250 | 18.7 | 17.2 | 3663 | 4308 | 51.1 | 39.9 |
| EXAMPLE D3 | 2200 | 250 | 20.4 | 17.9 | 3513 | 3850 | 58.1 | 46.4 |
| EXAMPLE D4 | 2200 | 450 | 28.6 | 26.3 | 3717 | 4848 | 76.9 | 54.2 |



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STEPS ARE FORMED ON SIDEWALLS TRENCHES INVERSELY SLIGHTLY SLIGHTLY TAPERED BOWING NOTE OF. EDGE 21.8 17.5 19.6 15.3 Si ETCH SELEC-TIVITY CEN-TER 15.7 16.3 14.2 17.5 3µmф TRENCH ETCH WITH RESIST MASK EDGE 3016 5475 8538 9144 RESIST E/R (Å/min) CEN-TER 4118 6348 8796 8963 EDGE 13.08 16.02 10.71 9.9 (µm/min) Si E/R CEN-10.33 12.48 15.72 TER 6.5 RATE (sccm) FLOW **0** 120 120 120 180 SURE (mTorr) PRES-130 230 350 350 RF R (w) 1000 1000 450 9 **EXAMPLE** EXAMPLE **EXAMPLE** EXAMPLE F2 F4 됴 Ξ

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TAPER ANGLE (deg) 85.9 88.3 87.3 86.9 87.5 86.8 86.4 86.5 87.7 85.7 86.7 Si E/R (µm/ min) 5.72 6.05 6.54 5.76 5.34 6.30 7.30 6.28 7.19 6.60 6.62 4.84 5.62 5.30 6.91 7.27 5.71 4.61 (Si/Si02) SELEC-Si ETCH TIVITY 21.2 22.4 24.2 31.9 35.0 37.0 21.3 32.0 36.7 36.8 21.0 24.4 24.8 35.5 40.8 24.4 24.7 10µm 2 μm 10µm 1µm 1µm 2µm TEM. 1 mm 2µm 10µm 1 mm 2µm 1µm 2µm 10µm 2µm 10µm 10µm TRENCH LENGTH LOCA-NOL EDGE EDGE EDGE CEN-CEN-CEN-TER TER TER TIME (sec) 8 9 9 EDGE **PRESSURE** \$ 5 **\$** BACK (Torr) CEN TER 5 5 ~ POWER € 품 650 650 500 (mTorr) PRES-SURE 100 2 2 SF6/02 (150/90) SF6/02 (150/90) SF6/02 (150/90) ETCHING (sccm) FLOW RATE GAS COMPA-RATIVE EXAMPLE EXAMPLE EXAMPLE RATIVE COMPA-COMPA-RATIVE ဗွ

1.2µm-WIDTH TRENCH ETCH

F16.2

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TAPER ANGLE 87.8 (deg) 87.8 87.6 86.9 87.3 87.3 87.8 87.7 87.7 87.1 87.1 87.1 5.38 6.14 15.13 6.40 6.59 6.97 10.69 11.56 12.04 11.70 13.17 13.05 14.44 14.36 16.94 6.01 12.61 15.71 Si E/R (µm/ min) (Si/Si02) Si etch Selec-TIVITY 20.5 24.4 31.9 34.3 36.3 23.4 25.3 26.3 30.7 33.0 34.5 25.6 26.8 28.9 26.4 23.1 10µm 10µm 10µm 10µm 10µm 1µm 2µm 1µm 2µm 1µm 2µm 10µm 1 m m 2µm 1 m 1µm 2µm LENGTH TRENCH LOCA-TION EDGE EDGE EDGE CEN-TER CEN-TER CEN-TER TIME (sec) ဓ္ဌ 9 30 EDGE PRESSURE 4 8 40 BACK (Torr) CEN-TER 5 5 15 POWER 2000 1400 € 650 (mTorr) PRES-Sure 250 170 2 SF6/02 SF6/02 SF6/02 / **SiF**4 (150/90 **ETCHING** / **SiF**4 (150/90 / SiF4 (150/90 FLOW RATE (sccm) GAS /20) /20) /20) **EXAMPLE EXAMPLE EXAMPLE** E3 Ш **E**2

1.2µm-WIDTH TRENCH ETCH

F16.22

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88.8 89.0 88.7 88.4 88.6 88.5 ANGLE TAPER 88.7 (deg.) 10.00 9.25 9.95 10.88 10.86 Si E/R (µm/mi 11.69 7.39 8.54 9.16 7.68 9.02 <u>_</u> 52.9 56.8 57.7 62.6 67.5 37.9 43.8 47.0 43.2 SELEC-TIVITY 50.7 (Si/Si02) Si ETCH 10µm 10µm 1µm 10µm 1µm 2րտ 1 En 2µm 1µm 2µm TRENCH LENGTH 1.2µm-WIDTH TRENCH ETCH CENTER LOCA-CENTER TION EDGE EDGE TIME (sec) 30 8 EDGE BACK PRESSURE **6** 40 (Torr) CEN TER 5 5 RF POWER € 1400 1400 (mTorr) PRES-SURE 170 170 SF6/02/ ETCHING SF6/02/ SiF4 (150/90/ FLOW RATE SiF4 (150/90 /350) (sccm) GAS 350) **EXAMPLE EXAMPLE E**4 E5

F16. 23